MOTOROLA

May 10, 1994

Mr. William Caton
Acting Secretary
Federal Communications Commission
1919 M Street, N.W., Room 222
Washington, DC 20554

Reference: General Docket 90-314

Dear Mr. Caton:

On May 9 officials of Motorola and AT&T met jointly with Julius Knapp and Phil Inglis to discuss unlicensed PCS. Attached is a copy of written material used in this meeting.

Regards,

Jerry Leonard
Corporate Vice President

Attachment
cc: Julius Knapp
Phil Inglis

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FCC MEETING 5/9/94

AGENDA

- SUMMARY
- MULTIPLE SYSTEM SHARING ANALYSIS
- SINGLE SYSTEM ANALYSIS
- PROVIDING FAIR ACCESS TO SPECTRUM
- RECOMMENDATIONS

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SUMMARY

WHY 1.25 MHZ CHANNELS?

- WINForum Sharing Principles for Isochronous Sub-band Require Many Narrow Channels for Spectrum Sharing
  - 1.25 MHz Provides Sufficient Number of Servers Per Channel and Suitable Number of Channels for Reuse

- Limiting Spectrum Occupancy of Each Cell is Necessary to Provide for Frequency Reuse Between Different Cells and/or Systems and to Promote Fair Access to the Spectrum within a Co-Located Geographic Area.
  - Propagation Modeling Shows that the Size of a Co-Located Geographic Area is Substantial.

SUMMARY

WHY NOT 5 MHZ CHANNELS?

- Spectrum Efficiency of Wide Bandwidth Systems are Lower than Narrower Bandwidth Systems in a Co-Located Multiple System Environment
  - Analysis Example: 1.25 MHz Channels Improve User Density in a Co-Located Geographic Area by 300% to 650% Compared to 5 MHz Channels

- Spectrum Efficiency of a Wide Bandwidth (5 MHZ) Spread Spectrum System is Lower than a Narrower Bandwidth(1.25 MHZ) Non-Spread Spectrum System in an In-Building Single System Environment
  - Analysis Example: Narrower Bandwidth System Provides 470% Higher User Density than Spread Spectrum System

- 5 MHz Channelization Restricts Fair Access To Spectrum
  - Example: 5 MHz Channelization Permits Two Wide Bandwidth Cordless Telephones to Monopolize 10 MHz of Spectrum

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MULTIPLE SYSTEM SHARING ANALYSIS MODEL

Spectrum Efficiency of a System in

a Co-Located Multiple System Environment

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MULTIPLE SYSTEM SHARING ANALYSIS MODEL

- Lower 10 MHz Sub-Band Analyzed (1890-1900 MHz)
- Multiple Systems are within a Co-Located Geographic Area
- Systems Analyzed:

	Channelization	
	1.25 MHz	5 MHz
Single User, Single Cell Low Capacity System	1.25 MHz BW CDMA Cordless Telephone	5 MHz BW CDMA Cordless Telephone
Multi-User, Single Cell High Capacity System	1.25 MHz BW WCPE System	5 MHz BW SS TDMA System

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MULTIPLE SYSTEM SHARING ANALYSIS MODEL

- **Audio Coding:** 32 kBPS ADPCM
- **System Sitings:** Co-Located
- **Antenna Gain:** 0 dBi
- **Power Control:** None
- **Traffic / User:** 0.2 Erlangs
- **Blocking:** ≤ 0.5 %

MULTIPLE SYSTEM SHARING ANALYSIS

- Duplex Voice Channels / MHz

	System	Duplex Channels / MHz
Low Capacity Systems	1.25 MHz BW CDMA Cordless Telephone	0.8
	5 MHz BW CDMA Cordless Telephone	0.2
High Capacity Systems	1.25 MHz BW WCPE System	9.6
	5 MHz BW SS TDMA System	1.6

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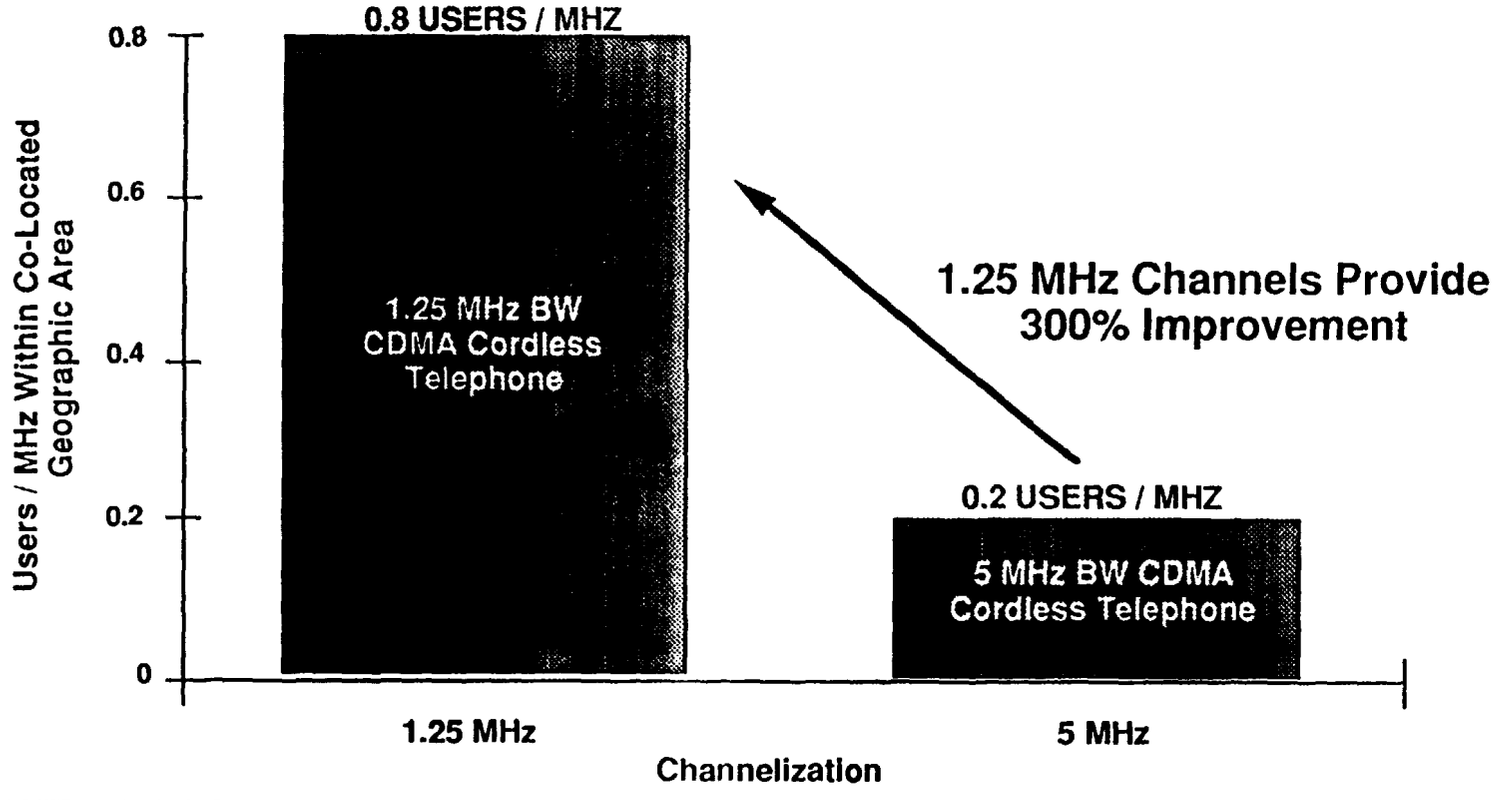
SHARING ANALYSIS - Low Capacity Systems

Single User, Single Cell System Spectrum Efficiency Within Co-Located Geographic Area



Analysis Example: 1.25 MHz Channels Improve User Density in a Co-Located Geographic Area by 300% Compared to 5 MHz Channels

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SHARING ANALYSIS - High Capacity Systems

Multi-User, Single Cell System Spectrum Efficiency Within Co-Located Geographic Area

Traffic Model: Lost Calls Held; Finite Sources

	1.25 MHz BW WCPE System	5 MHz BW SS TDMA System
BW	1.25	5
Channels	12	8
Users	28	15
Users / MHz	22.4	3.0

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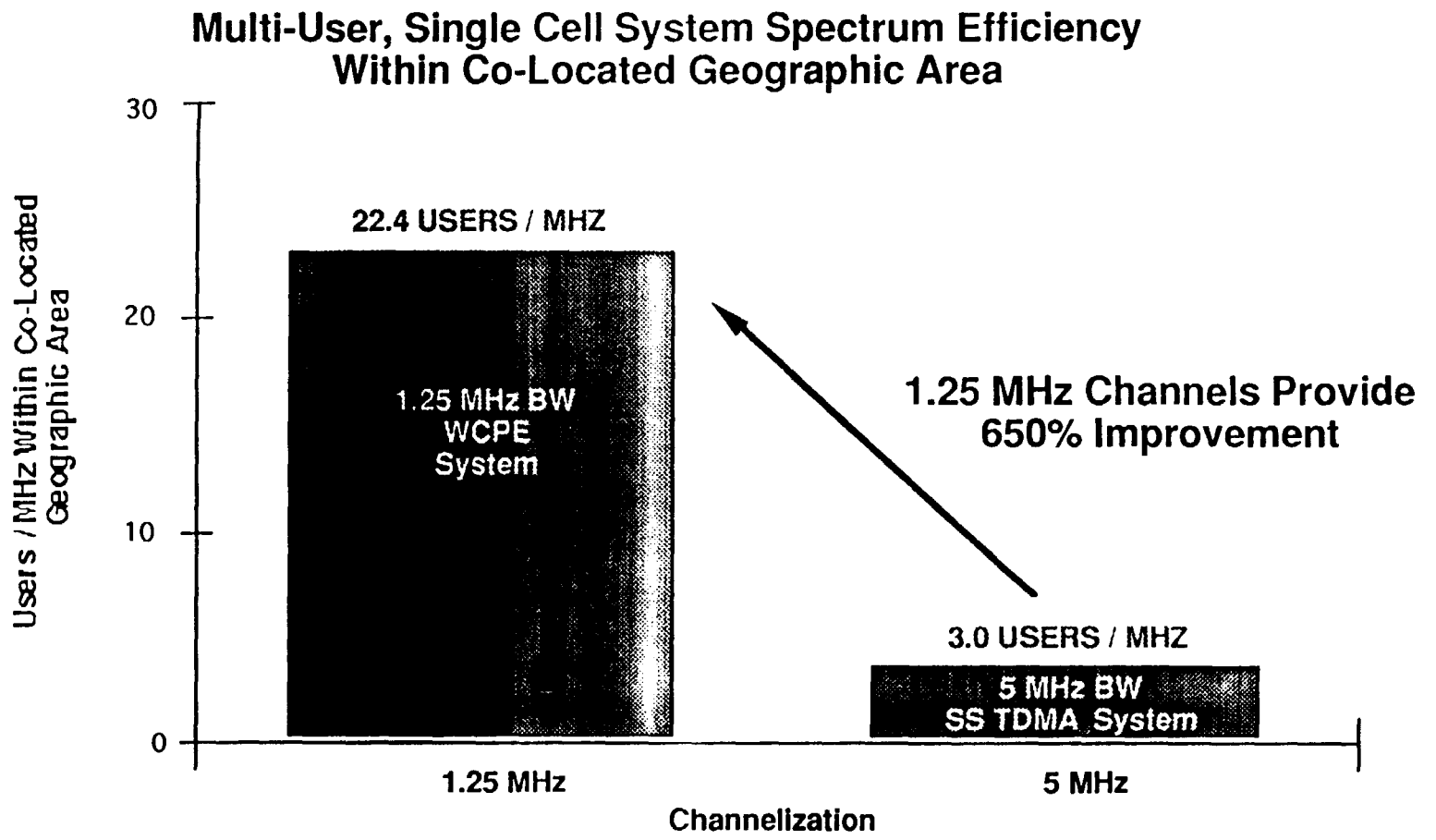
SHARING ANALYSIS - High Capacity Systems



Analysis Example: 1.25 MHz Channels Improve User Density in a Co-Located Geographic Area by 650% Compared to 5 MHz Channels

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SINGLE SYSTEM ANALYSIS

Spectrum Efficiency of a System in

an In-Building Single System Environment

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CHANNEL EFFICIENCY OF VARIOUS SYSTEMS

PARAMETER	CT2	DECT	PHP	WCPE Class I	WCPE Class II	WIDE BAND SS TDMA
RF Channel Spacing (kHz)	100	1728	300	1250	625	5000
Duplex (User) Channels / RF Channel	1	12	4	12	6	8
Duplex (User) Channels / MHz	10	6.9	13.3	9.6	9.6	1.6

Note: Duplex (user) channels utilize 32 kbit ADPCM coding for audio signals

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SINGLE SYSTEM CAPACITY ANALYSIS MODEL

- Systems operate independently of each other
- Lower 10MHz sub-band is analyzed (1890-1900MHz).
- Capacity is for an in-building single floor hexagonal cell pattern.
- All audio signals use 32 kbit ADPCM.
- RF shadowing variations are excluded for simplicity.
- In-building propagation measurements at 900 MHz are scaled to 1.9 GHz.
- Power control is implemented so that interference levels do not exceed LBT thresholds.
- All systems utilize dynamic channel allocation.

SINGLE SYSTEM TRAFFIC CAPACITY ANALYSIS

PARAMETER	ANALYSIS EXAMPLE	
	WCPE Class I	WIDE BAND SS TDMA
RF Channel Spacing (kHz)	1250	5000
Duplex (User) Chan. / RF Chan.	12	8
Duplex (User)Channels / 10MHz	96	16
Total Erlangs / Cluster (0.5% GOS, Erlang B)	77.2	8.1
Indoor Reuse Factor (1) (20m Cell)	6.1	3.7
Erlangs / Cell	12.6	2.2
Total Users / Cell (0.2E/User)	63	11

Note 1 : Reuse factor will increase by a factor ranging from 2 to 4 for a multiple floor environment.

- The Additional Bandwidth Used By a Spread Spectrum System Does Not Reduce the In-Building Reuse Factor Sufficiently to Achieve the Equivalent Number of Users Per Cell as a Non-Spread Spectrum System

Analysis Example: 1.25 MHz Channels Improve User Density in a Co-Located Geographic Area by 470% Compared to 5 MHz Channels

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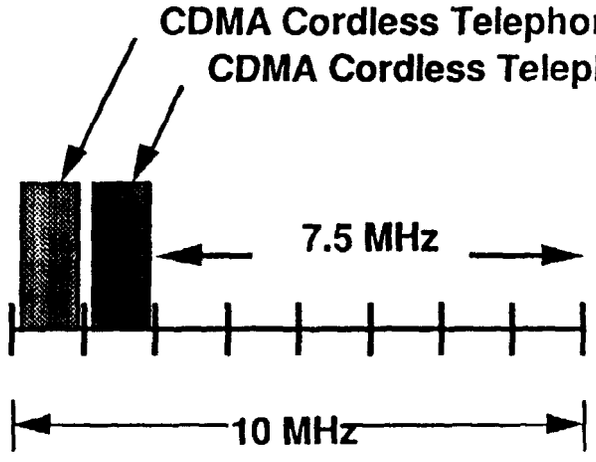
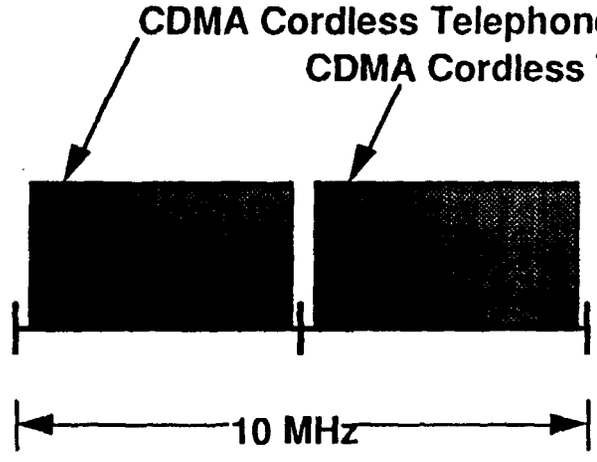
SHARING ANALYSIS - Providing Fair Access to Spectrum

1.25 MHz Channels



- 7.5 MHz of Spectrum Available for Other Co-Located Systems

5 MHz Channels



- No Spectrum Available for Other Co-Located Systems
  - Other Systems Blocked and Denied Access to Spectrum

1.25 MHz Channelization Promotes Fair Access To Spectrum and Prevents Monopolization of a Large Amount of Spectrum by a Single Device in a Co-Located Geographic Area

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RECOMMENDATIONS

- **Maintain the 1.25 MHz Channels in the 1920 to 1930 MHz Sub-band.**
- **Change the Channelization of the 1890 to 1900 MHz Sub-band from 5 MHz Channels to the *Originally Proposed* 1.25 MHz Channels.**

Justifications:

(1) WINForum Sharing Principles for Isochronous Sub-band Require Many Narrow Channels for Spectrum Sharing

- **1.25 MHz Bandwidth Channels Provide Sufficient Number of Servers per Channel and a Suitable Number of Channels for Reuse.**

RECOMMENDATIONS

Justifications (cont.):

(2) Limiting Spectrum Occupancy of Each Cell is Necessary to Provide for Frequency Reuse Between Different Cells and/or Systems and to Promote Fair Access to the Spectrum within a Co-located Geographic Area

- **Propagation Modeling Shows that the Size of a Co-Located Geographic Area is Substantial.**

(3) 5 MHz Channelization Restricts Fair Access to Spectrum

- **Example: Allows Two Wide Bandwidth Cordless Telephones to Monopolize 10 MHz of Spectrum**

(4) Spectrum Efficiency of Wide Bandwidth Systems is Significantly Lower than Narrower Bandwidth Systems in a Co-Located Multiple System Environment.

- **Analysis Example: 1.25 MHz Channels Improve User Density in a Co-Located Geographic Area by 300% to 650% Compared to 5 MHz Channels**

RECOMMENDATIONS

Justifications (cont.):

(5) Spectrum Efficiency of a Wide Bandwidth (5 MHz) Spread Spectrum System is Significantly Lower than a Narrower Non-Spread Spectrum System in an In-Building Single System Environment.

- Analysis Example: Narrower Bandwidth System Provides 470% Higher User Density than Spread Spectrum System

- Wide Bandwidth Spread Spectrum System Enabled by 5 MHz Channels Results in Lower User Density and Lower Utility for the Spectrum.

ADDITIONAL CONSIDERATIONS

- 1.25 MHz Channels Can Deliver Bit Rates Comparable to Wide Bandwidth Spread Spectrum Systems. These Bit Rates are Sufficient to Support a Wide Range of User Applications.

- The Lower Number of Users Supported by 5 MHz Channelization Negatively Impacts the Ability to Clear the Sub-Band.

- 5 MHz Channelization Adversely Affects the Quality of Service that Can Be Provided within a Co-Located Multiple System Environment Due to the Potentially High Probability of Blocking.